ПОЛЕВОЙ ЖУРНАЛ БИОЛОГА. 2022. Том 4, № 1 (80–90)
FIELD BIOLOGIST JOURNAL. 2022. Volume 4, No. 1 (80–90)

БИОЛОГИЧЕСКИЕ РЕСУРСЫ
BIOLOGICAL RESOURCES

УДК 581.6: 574.34: 635.744
DOI 10.52575/2712-9047-2022-4-1-80-90

Cenopopulations of *Hyssopus officinalis* L. in the Belgorod Region: Spatial Structure and Bioresource Potential

Sergei V. Filatov [1], Dmitriy V. Dumachev [2]
[1] Korochansk agricultural college,
62 International St, Korocha, Belgorod region 309210, Russian Federation
E-mail: senator31@yandex.ru
[2] Belgorod Oncological Dispensary,
1 Kuibysheva St, Belgorod 308010, Russian Federation
E-mail: orionim@mail.ru

Received November 7, 2021; Revised November 14, 2022; Accepted March 11, 2022

Abstract. Seven cenopopulations of *H. officinalis* L. were studied in the basin of the Manzhokha River in the south of the Central Russian Upland. The area of hyssop cenopopulations varies from 570 to 9000 m^2; the number of specimens – from 347 to 1.340; the density of cenopopulations – from 0.22 to 0.74 specimens/m^2. Specimens of *H. officinalis* L. in cenopopulations are characterized by a random group arrangement. The resistance of *H. officinalis* L. specimens on the slopes along the roads was shown. This makes the culture promising for green building and for strengthening the slopes of the roads. During the flowering period, *H. officinalis* L. forms thickets with a productivity from 281.1 to 871.1 kg of raw material. Cenopopulations growing on chalk outcrops are promising for the collection of *H. officinalis L.* raw materials. In all habitats, individuals of *H. officinalis* L. have stable seed productivity in the range from 6.56 to 9.54 g per individual.

Keywords: species richness, green mass productivity, seed productivity, biological resources, Central Russian Upland

For citation: Filatov S.V., Dumachev D.V. Cenopopulations of *Hyssopus officinalis* L. in the Belgorod Region: Spatial Structure and Bioresource Potential. *Field Biologist Journal*, 4(1): 80–90. DOI: 10.52575/2712-9047-2022-4-1-80-90

Ценопопуляции *Hyssopus officinalis* L. в Белгородской области: пространственная структура и биоресурсный потенциал

С.В. Филатов [1], Д.В. Думачев [2]
[1] Корочанский сельскохозяйственный техникум,
309210, Белгородская область, г. Короча, ул. Интернациональная, 62
[2] Белгородский онкологический диспансер,
308010, г. Белгород, ул. Куйбышева, 1
E-mail: senator31@yandex.ru; orionim@mail.ru

Поступила в редакцию 07.11.2021; поступила после рецензирования 14.11.2021; принята к публикации 11.03.2022

Аннотация. Изучены семь ценопопуляций *H. officinalis* L. в бассейне реки Манджоха на юге Среднерусской возвышенности. Площадь ценопопуляций иссопа изменяется в пределах от 570 до

9000 м^2; число особей – от 347 до 1 340 экз.; плотность ценопопуляций – от 0,22 до 0,74 экз./ м^2. Для особей *H. officinalis* L. в ценопопуляциях характерно случайно-групповое расположение. Показана устойчивость особей *H. officinalis* L. на склонах вдоль дорог. Это делает культуру перспективной для зеленого строительства и при укреплении склонов дорог. В период цветения *H. officinalis* формирует заросли с продуктивностью 281,1… 871,1 кг сырого вещества. Перспективными для сбора сырья *H. officinalis* L. являются ценопопуляции, растущие на меловых обнажениях. Во всех местообитаниях особи *H. officinalis* L. имеют стабильную семенную продуктивность в пределах 6,56… 9,54 г на особь.

Ключевые слова: экземплярная насыщенность, продуктивность зеленой массы, семенная продуктивность, биологические ресурсы, Среднерусская возвышенность

Для цитирования: Филатов С.В., Думачев Д.В. 2022. Ценопопуляции *Hyssopus officinalis* L. в Белгородской области: пространственная структура и биоресурсный потенциал. *Полевой журнал биолога*, 4(1): 80–90 (на англ.). DOI: 10.52575/2712-9047-2022-4-1-80-90

Introduction

Species of the genus Hyssopus L. belong to the most ancient medicinal plants known since the time of Hippocrates. Even genus specific name – *Hyssopus officinalis* L. – indicates its valuable medicinal properties. Hyssop has antiseptic, anti-inflammatory, analgesic, wound healing, mild stimulating, antitussive properties [Javadi et al., 2017]. Among the wide variety of and genetically related to steroids, are of particular interest for physicians and pharmacologists (in particular, pentacyclic triterpenic acids – ursolic and oleanolic, possessing hepatoprotective, antiviral and antitumor activity) [Tahir et al., 2018].

As a medicinal raw material for *H. officinalis*, flowering leafy shoots are used, which are cut off during the flowering period in July-August [Popova, Mihaylova, 2018]. Dried in the shade in a ventilated room or in a dryer at a temperature not exceeding 30–40 °C. The content of the essential oils complex in the aboveground mass of hyssop, according to various sources, in green leaves and inflorescences is from 0.8–2.0 to 2.5–3.0 %, in dry grass – 0.6–1.0 % of the essential oils [Fathiazad, Hamedeyazdan, 2011; Guardo et al., 2017].

The main components of the essential oil are geraniol, borneol, thujone, fellandrene, pinocampon. In addition, the plant contains flavonoids, ursolic and oleic acids, tannins and bitter substances, resins, gums, pigments, etc. Medical institutions are also using hyssop for the prevention of infectious diseases – for medical phytodesign. In addition, hyssop is also used as a source of raw materials for the perfumery industry, and is also a valuable melliferous crop [Evstatieva et al., 2007; Dumacheva et al., 2015; Chernyavskikh et al., 2019 a, b; Semerdjieva et al., 2019; Zagorcheva et al., 2020].

All of the above makes the species *H. officinalis* promising for studying in places of its natural growth.

In the Belgorod Region, scientists of the Belgorod State University study the flora and vegetation of the region, the distribution of medicinal and food wild plants, adventives species and introduced species [Tokhtar' et al., 2011; Chernyavskih et al., 2012; 2013; 2018; Kurskoy et al., 2014]. The region has a high biodiversity. *H. officinalis* is an introduced species in the Belgorod region. The first cenopopulations were identified in the Volokonovsky district about 30 years ago [Dumacheva et al., 2015].

Populations of *H. officinalis* formed in gully complexes on eroded chernozems and disturbed residual calcareous soils of the Belgorod region. Populations of medicinal hyssop were found in the Belgorod region between the villages of Nizhnie Lubyanka and Verkhniye Lubyanka (Volokonovsky district); at the source of the Useredets River near the village of Staraya Bezginka (Novooskolsky District) [Dumacheva et al., 2015; Dumacheva et al., 2018]. Breeders of Belgorod State University have created two varieties of *H. officinalis* – ‘Volokonovsky’ (2018) and ‘Lazar’ (2020) [Dumacheva et al., 2017, 2019].

The goal of the work was to study the bioresource potential and raw material base of the species *H. officinalis* in the basin of the small river Mandzhokha, Belgorod region.

Material and methods

The study area included the southeastern macroslope of the Central Russian Upland within the Belgorod Oblast of the Russian Federation. There are widespread landscapes with calcareous soils and chalk outcrops [Cherniavskih, 2009, 2016; Dumacheva, Cherniavskih, 2014].

The climate of the studied area is moderately continental. Its main features: large annual temperature range, relatively mild winters with frequent thaws and snowfalls; sunny, long summer; moderate and not quite stable humidification with predominance of summer precipitation. The amount of precipitation does not exceed 525–585 mm.

A feature of the Belgorod region is a high agricultural and industrial development of the territory, a high level of the erosion processes development. The territory has a fairly high indented ravines and ravines with a density of about 1.5 km/ km^2.

The territory is characterized by the maximum uplift within the south of the Central Russian Upland – up to 272–276 m above sea level. Soils: gray forest, typical chernozems, leached and podzolized. Agricultural lands occupy about 60 % of the area [Lisetsky et al., 2019; Cherniavskih et al., 2019 d].

Field research in 2016–2018 were carried out according to the methods of geobotanical and biogeocenological studies [Programma i metodika…, 1966].

The methodological basis of research: the doctrine of the centers of origin and diversity of cultivated plants, microgencenters (secondary anthropogenic gene centers), the theory of the formation of a secondary anthropogenic microgencenter in the Cretaceous south of the Central Russian Upland [Cherniavskih et al., 2019 a, b, c].

Seven cenopopulations of *H. officinalis* were the objects of study. Populations were selected in different habitats (Table 1).

Three large cenopopulations of *H. officinalis* were identified in the Mandzhokha River basin on the slopes along the road cut: CPH-11, CPH-12, CPH-13.

Cenopopulation CPH-21 is located at the bottom of a gully, on a pasture in the upper reaches of the Mandzhokha River.

Three cenopopulations of *H. officinalis* were found on the chalk outcrops on the slope above the road: CPH-31, CPH-32, CPH-33.

Table 1
Таблица 1

The hyssop habitats studied in the experiment
Изученные в опыте местообитания иссопа

Cenopopulation Ценопопуляция	Habitats Местообитания	Geographical coordinates Географические координаты
CPH-11	A slope along a road cut	N 50.452539 E 37.779710
CPH-12	A slope along a road cut	N 50.449861 E 37.803149
CPH-13	A slope along a road cut	N 50.447691 E 37.806393
CPH-21	The bottom of the gully, in the pasture in the upper reaches of the Mandzhokha River	N 50.459335 E 37.739115
CPH-31	Chalk outcrops on the slope above the highway	N 50.453519 E 37.811321
CPH-32	Chalk outcrops on the slope above the road	N 50.458624 E 37.815128
CPH-33	Chalk outcrops on the slope above the road	N 50.461569 E 37.818080

The area of each hyssop cenopopulation within natural boundaries (m^2) was estimated. In each cenopopulation, test plots of (10 × 10) m were laid. The test plots provided a fairly complete picture of the studied cenopopulations. In each test site, 4 counting sites with a size of 1 × 1 m were laid. The boundaries of each test site and counting site were marked with wooden pegs. On each test site, the number of hyssop individuals was counted. The absolute number of individuals on each site and the specimen saturation were determined by the calculation method [Programma…, 1966].

To assess the productivity of green mass, 20 hyssop plants were cut at each plot at ground level during the flowering phase. Plants were selected at random. To assess seed productivity, 10 plants were randomly selected from each plot. The plants were cut down at ground level.

The beginning of the passage of phenological phases, the number of early flowering and late flowering individuals were noted. The density of bushes, the height of individuals in the phase of technical ripeness and in the phase of seed ripening, the degree of pubescence, the length and width of leaves, the number of whorls in inflorescences, the number of inflorescences, the length and width of inflorescences, and the size of flowers were determined.

Leafiness was estimated as a percentage. For this, the mass of leaves from one plant was multiplied by 100 and divided by the total mass of leaves and stems. The results were statistically processed.

Results and discussion

The carried-out route studies made it possible to assess the spread of the new culture over the territory of the Mandzhokha River basin. The distance between ecological points in our studies ranged from 5 to 15 km. The results of studying the spatial structure of *H. officinalis* cenopopulations at the reference stationary points are presented on Table 2.

Table 2
Таблица 2

Spatial structure of *H. officinalis* cenopopulations in the Manjokha river basin
Пространственная структура ценопопуляций *H. officinalis* в бассейне реки Манджоха

Cenopopulation Ценопопуляция	Square, m^2 Площадь, $м^2$	Absolute number of individuals, ex. Абсолютное число особей, экз.	Species richness (density), ex./ m^2 Экземплярная насыщенность (плотность), экз./ $м^2$
CPH-11	9 000	670	0.74
CPH-12	700	470	0.67
CPH-13	1 600	630	0.39
CPH-21	3 400	750	0.22
CPH-31	890	576	0.65
CPH-32	570	347	0.61
CPH-33	2 880	1 340	0.46
Average	2 720	683	0.53
Cv*, %	134.1	66.2	33.4

Note: Cv * – coefficient of variation.

The area of *H. officinalis* cenopopulations on the slopes along the road cut (CPH-11, CPH-12, CPH-13) varied widely – from 700 to 9 000 m^2, averaging 3 767 m^2. Three large cenopopulations of *H. officinalis* were identified in the area of the Mandzhokha River on the slopes along the road cut: CPH-11, CPH-12, CPH-13. The area of these hyssop cenopopulations varied over a wide range – from 700 to 9 000 m^2, averaging 3 767 m^2. The number of individuals varied with-

in narrower limits – from 470 to 670 specimens, averaging 590 specimens, specimen saturation (density) varied from 0.39 to 0.74, leaving an average of 0.6 pcs / m^2.

The CPH-21 cenopopulation is located at the bottom of a ravine, on a pasture in the upper reaches of the Mandzhokha River. This cenopopulation is the second largest in terms of area after the CPH-11 site. But in terms of specimen saturation, it is minimal – 0.22 pcs / m^2.

The area of cenopopulations on the Cretaceous outcrops (CPH-31, CPH-32, CPH-33) varied from 570 to 2 880 m^2, averaging 1 447 m^2, the absolute number of individuals averaged 754 individuals, and the average density was 0.57 pcs / m^2.

It was found that individuals of hyssop are characterized by a random-group arrangement. An assessment was made of the size of groups of hyssop individuals in natural habitats. The most common are the aggregations, the number of which varies from 17 to 60 individuals or more. On average, the number of plants in one cenopopulation is about 683. The coefficient of variation is quite high – Cv = 66.2 %. The level of species richness of hyssop in our studies was about 0.53 pcs / m^2 (Cv = 33.4 %).

The maximum density of hyssop specimens (0.74 pcs / m^2) was characteristic of the CPH-11 cenopopulation near the road.

The largest population was the CPH-33 cenopopulation, located above the road on a chalk slope – 1.340 pcs.

Cenopopulations CPH-11 are distinguished by individuals with tall dense bushes, while cenopopulations CPH-12 and CPH-13 have dense bushes of medium height.

The height of plants in the phase of technical ripeness varies from 46 cm in individuals of the CPH-12 cenopopulation to 57 cm in individuals of the CPH-11 cenopopulation; in the flowering phase – from 53 cm in CPH-13 to 64 cm in individuals of the CPH-11 cenopopulation; in the seed maturation phase – from 58 cm in CPH-13 individuals to 75 cm in individuals of the CPH-11 cenopopulation.

The leafiness of individuals varies from 44 % in individuals of the CPH-11 cenopopulation to 48 % in individuals of the CPH-12 cenopopulation.

The average leaf length varies from 1.9 cm in individuals of the CPH-11 cenopopulation to 2.8 cm in individuals of the CPH-13 cenopopulation.

The average leaf width varies from 0.7 cm in individuals of the CPH-12 cenopopulation to 1.3 cm in individuals of the CPH-13 cenopopulation.

Inflorescences in the studied cenopopulation differ in the number of whorls on inflorescences: from 16.4 pcs for CPH-13 up to 17.9 pcs at CPH-11.

The flowering time in individuals of the studied cenopopulations differs. In cenopopulation CPH-11, the proportion of early flowering individuals is 10 %. Cenopopulation CPH-12 has early flowering 5 %, while CPH-13 has late flowering.

The length of flowering parts in inflorescences varies from 13.1 cm in CPH-12 individuals to 17.8 cm in CPH-11 individuals. Width – from 1.6 cm in CPH-11 to 2,1 cm in CPH-13. The number of inflorescences varies from 59.5 pcs for CPH-13 up to 73.2 pcs at CPH-11.

Individuals of the local cenopopulation CPH-21 have loose bushes of medium height. Plant height varies from 47 cm in individuals in the technical ripeness phase to 64 cm in the seed ripening phase. The stem has an average degree of pubescence. The leafiness of individuals is about 44 %. The average length of the leaves is 3.1 cm, the width is 1.2 cm.

The number of whorls in the inflorescences of the CPH-21 cenopopulation is 16.2 pcs. The number of early flowering individuals does not exceed 15.

The length of the flowering parts of the inflorescences of the CPH-21 cenopopulation is the maximum among all those studied – 21.8 cm with a width of 1.9 cm. The size of the flowers is also maximum – 11.6 mm. The number of inflorescences reaches 73.5 pcs.

Cenopopulation CPH-31 has low spreading bushes, while cenopopulation CPH-32 has bushes of medium height, dense, and bushes of CPH-33 are of medium height, spreading.

Plant height in the phase of technical ripeness varies from 35 cm in the special cenopopulation CPH-31 to 42 cm in individuals of the cenopopulation CPH-32; in the flowering phase – from 46 cm in CPH-31 to 58 cm in individuals of the CPH-33 cenopopulation; in the phase of seed maturation – from 49 cm in CPH-31 individuals to 66 cm in individuals of the CPH-33 cenopopulation.

The leafiness of individuals varies from 46 % in individuals of the CPH-33 cenopopulation to 51 % in individuals of the CPH-31 cenopopulation.

The average leaf length varies from 2.2 cm in individuals of the CPH-31 cenopopulation to 2.7 cm in individuals of the CPH-32 cenopopulation. The average leaf width varies in a narrow range from 1.1 cm in individuals of the CPH-31 and CPH-32 cenopopulations to 1.4 cm in individuals of the CPH-33 cenopopulations.

Inflorescences in the studied cenopopulations differ in the number of whorls on inflorescences: from 14.8 pcs for CPH-33 up to 17.6 pcs from CPH-32.

The flowering time in individuals of the studied local cenopopulations differs. In cenopulation CPH-31, the proportion of early flowering individuals is 10 %. For cenopulations CPH-32 and CPH-33 – apply late flowering.

The length of flowering parts in inflorescences varies from 13,7 cm in CPH-33 individuals to 17.8 cm in CPH-32 individuals. Width – from 1.7 cm in CPH-31 to 2.1 cm in CPH-33.

The number of inflorescences in the second year of vegetation varies from 61.0 pcs for CPH-31 up to 71.2 pcs from CPH-33.

The assessment of the total productivity of aboveground phytomass and seed productivity of individuals in local cenopopulations has been carried out. It has been shown that there is a fairly strong interpopulation variation for all studied characters (Table 3).

Table 3
Таблица 3

Indicators of the total productivity of *H. officinalis* individuals in cenopopulations of the Mandzhokha River basin
Показатели общей продуктивности особей *H. officinalis* в ценопопуляциях бассейна реки Манджоха

Attribute Признак	Cenopopulation Ценопопуляция						
	CPH-11	CPH-12	CPH-13	CPH-21	CPH-31	CPH-32	CPH-33
Aboveground phytomass of one specimen, kg of wet matter Надземная фитомасса одной особи, кг сырого вещества	1.21±0.06	1.46±0.05	1.14±0.05	0.98±17	0.76±0.04	0.81±0.03	0.65±0.03
Seed weight per specimen, g Масса семян с одной особи, г	9.54±1.1	7.85±1.5	7.09±1.3	6.56±1.1	7.25±0.9	9.04±1.3	6.77±1.2
Weight of 1000 seeds, g Масса 1000 семян, г	1.4±0.02	1.2±0.04	1.3±0.06	1.4±0.05	1.2±0.04	1.3±0.06	1.2±0.06

By the value of the aboveground phytomass of one individual, the studied wild cenopopulations can be ranked in decreasing order: CPH-11 → CPH-12 → CPH-13 → CPH-21 → CPH-32 → CPH-31 → CPH-33. Individuals of hyssop from cenopopulations that grew in residential areas near the road have an average phytomass of 1.27 kg. This is 29.6 % higher than that of the

CPH-21 cenopopulation in the pasture, and 71.6 % higher than that of the cenopopulations on the chalk outcrops. On chalk outcrops, the average phytomass of hyssop individuals does not exceed 0.74 kg (Fig. 1, 2).

Fig. 1. General view of cenopopulation CPH-11
Рис. 1. Общий вид ценопопуляции CPH-11

A B C

Fig. 2. Individual hyssop plants from different populations, ripening at different times:
A – cenopopulation CPH-12; B – cenopopulation CPH-21; C – cenopopulation CPH-33
Рис. 2. Индивидуальные растения иссопа из различных популяций, созревающие в разное время:
A – ценопопуляция CPH-12; B – ценопопуляция CPH-21;
C – ценопопуляция CPH-33

Individuals of two cenopopulations CPH-11 and CPH-32 had the maximum and similar seed productivity. In terms of this indicator, they exceeded all other cenopopulations by 21.5... 45.4 % on average.

The low seed productivity of individuals of the cenopopulation CPH-21 is possibly related to the fact that at the end of the growing season, during the period of seed reproduction, individuals of hyssop in the pasture are damaged by animals during grazing.

An important indicator, which, according to researchers, is genetically determined in plants, is the mass of 1 000 seeds. It is noteworthy that this indicator slightly differed between cenopopulations and varied in the range from 1.2 to 1.4 g. Apparently, when considering the studied hyssop cenopopulations, the founder effect cannot be excluded.

The Figure 3 shows the data on the total aboveground phytomass of the studied hyssop cenopopulations during the flowering period.

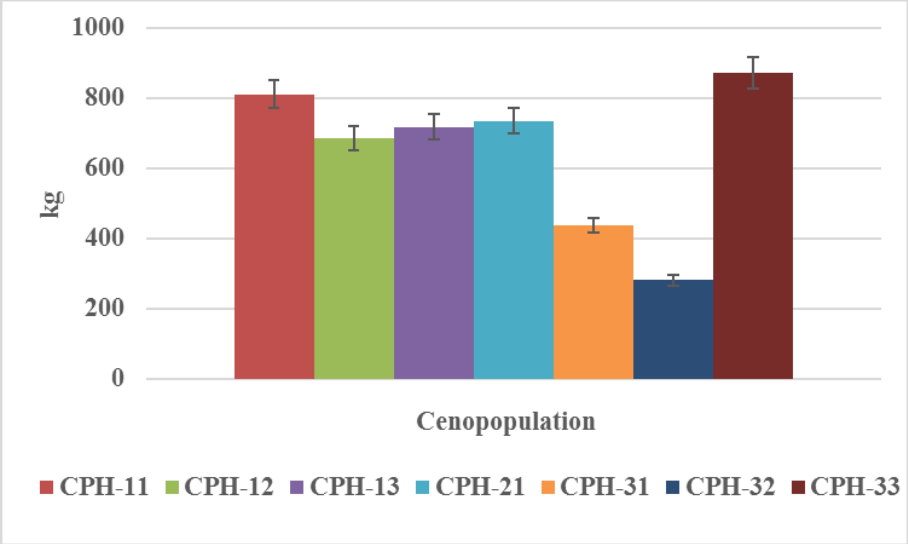

Fig. 3. Total aboveground phytomass of *H. officinalis* cenopopulations in the Mandzhokha River basin
Рис. 3. Общая надземная фитомасса ценопопуляций *H. officinalis* в бассейне реки Манджоха

In accordance with the Rules for the procurement of food forest resources and the collection of medicinal plants, the collection of aboveground organs («grass») of perennial plants is allowed once within 4–6 years [1, 2].

Cenopopulations, which are located near the road during the flowering period, form an average of 738.4 kg of aboveground phytomass. However, for the collection of hyssop raw materials, the cenopopulations CPH-11, CPH-12, CPH-13 cannot be used, since the proximity of the road increases the risk of contamination of the phytomass of the hyssop with heavy metals.

The study of these cenopopulations is of value, since it shows the stability of hyssop in conditions of anthropogenic pollution and the possibility of using this species for landscaping the roadside and slopes in road construction.

The CPH-21 cenopopulation growing in the pasture also forms a fairly large aboveground phytomass. However, the collection of raw materials on the pasture is also not recommended [Chukuridi et al., 2012].

[1] Pravila sbora i sushki lekarstvennykh rasteniy: (sb. instruktsiy) [Rules for the collection and drying of medicinal plants: (collection of instructions)]. 1985. M.: Meditsina, 328 p.

[2] Ob utverzhdenii pravil zagotovki pishchevykh lesnykh resursov i sbora lekarstvennykh rasteniy: Prikaz Ministerstva prirodnykh resursov i ekologii Rossiyskoy Federatsii [On the approval of the rules for the procurement of food forest resources and the collection of medicinal plants: Order of the Ministry of Natural Resources and Ecology of the Russian Federation]. 28.07.2020 No. 494 (14.12.2020, reg. № 61428)

Of the seven cenopopulations studied, only three coenopopulations (CPH-31, PH-32 and CPH-33) are located at a distance of more than 2 km from the highway. Cenopopulations growing on chalk outcrops are promising for collecting raw materials. The CPH-33 cenopopulation in terms of aboveground productivity exceeds the CPH-31 and CPH-32 cenopopulations by 1.99 and 3.09 times, respectively, due to its large area.

Conclusion

Thus, in the course of the research, stable in time cenopopulations of medicinal hyssop in the basin of the Mandzhokha River of the Volokonovsky District of the Belgorod Region were revealed. During the flowering period, hyssop forms thickets with a productivity of 281.1...8711 kg of wet matter. Individuals of hyssop have a seed productivity of 6.56...9.54 g per individual. Sufficiently close indicators of the aboveground productivity and the mass of 1000 seeds were obtained. This allows us to conclude that there is stable seed reproduction and the possibility of replacement renewal in the studied cenopopulations.

The studied hyssop cenopopulations can serve as a source of collecting valuable raw materials. They are also a place of selection of new initial forms with valuable traits and properties for breeding.

The authors are grateful to V.I. Cherniavskih, Doctor of Agricultural Sciences, Chief Scientific to the employee of the Natural and Landscape Complex "Botanical Garden of the National Research University" BelSU " for methodological assistance in planning and conducting research.

References
Список литературы

Dumacheva E.V., Chernyavskikh V.I., Borodaeva Zh.A. 2015. Biological resources family Lamiaceae Lindl. in the conditions of the cretaceous south of Central Russian Upland. *Sovremennyye problemy nauki i obrazovaniya*: 3: 616 p. (in Russian).

Думачева Е.В., Чернявских В.И., Бородаева Ж.А. 2015. Биологические ресурсы семейства Lamiaceae Lindl. в условиях мелового юга Среднерусской возвышенности. *Современные проблемы науки и образования*, 3: 616 p.

Dumacheva E.V., Chernyavskikh V.I. 2014. Biological potential of legumes in natural communities of erosive agricultural landscapes of the Central Chernozem region. Feed production, 4: 8–11 (in Russian).

Думачева Е.В., Чернявских В.И. 2014. Биологический потенциал бобовых трав в естественных сообществах эрозионных агроландшафтов Центрального Черноземья. *Кормопроизводство*, 4: 8–11.

Programma i metodika biogeotsenologicheskikh issledovaniy [Program and methodology of biogeocenological studies]. 1966. Ed. V.N. Sukacheva, N.V. Dylisa. M., Publ. Nauka, 334 p. (in Russian).

Программа и методика биогеоценологических исследований. 1966. Под. ред. В.Н. Сукачева, Н.В. Дылиса. М., Наука, 334 с.

Kurskoy A.Y., Tokhtar V.K., Cherniavskih V.I. 2014. Florisctic findings of alien and rare plant species in the south-west of the central Russian Upland. *Mezhdunarodnyy zhurnal prikladnykh i fundamental'nykh issledovaniy*, 9(3): 78–82 (in Russian).

Курской А.Ю., Тохтарь В.К., Чернявских В.И. 2014.Флористические находки адвентивных и раритетных видов растений на юго-западе Среднерусской возвышенности. *Международный журнал прикладных и фундаментальных исследований*, 9(3): 78–82.

Tokhtar' V.K., Tretyakov M. Yu., Cherniavskikh V.I., Fomina O.V., Mazur N.V., Groshenko S.A., Volobuyeva Yu. Ye., Petina V.I. 2011. Some approaches to assessment of anthropogenous impact on phytobiota. *Problemy regional'noy ekologii*, 2: 92–95 (in Russian).

Тохтарь В.К., Третьяков М.Ю., Чернявских В.И., Фомина О.В., Мазур Н.В., Грошенко С.А., Волобуева Ю.Е., Петина В.И. 2011. Некоторые подходы к оценке антропогенного влияния на фитобиоту. *Проблемы региональной экологии*, 2: 92–95.

Chernyavskih V.I. 2009. Productivity of legumes-grass mixture and effectiveness of their cultivation on the slope lands of the southwest of CCZ. *Achievements of Science and Technology in Agro-Industrial Complex*, 7: 42–45 (in Russian).

Чернявских В.И. 2009. Продуктивность бобово-злаковых травосмесей и эффективность их возделывания на склоновых землях юго-запада ЦЧЗ. *Достижения науки и техники АПК*, 7: 42–45.

Cherniavskih V.I. 2016. Rekurrentnaya selektsiya kak osnova povysheniya produktivnosti lyutserny v Tsentral'no-Chernozomnom regione [Recurrent selection as the basis for increasing the productivity of alfalfa if the Central Chernozem Region]. *Kormoproizvodstvo*, 12: 40–44.

Чернявских В.И. 2016. Рекуррентная селекция как основа повышения продуктивности люцерны в Центрально-Чернозёмном регионе. *Кормопроизводство*, 12: 40–44.

Chernyavskih V.I., Titovsky A.G., Sharko R.A., Shinkarenko O.V., Dumacheva E.V. 2012. Experience of breeding and seed production of alfalfa and other grasses in CJSC «Krasnaya Yaruga Grain Company». *Achievements of Science and Technology in Agro-Industrial Complex*, 12: 14–17 (in Russian).

Чернявских В.И., Титовский А.Г., Шарко Р.А., Шинкаренко О.В., Думачева Е.В. 2012. Опыт селекции и семеноводства люцерны и других трав в ЗАО «Краснояружская зерновая компания». *Достижения науки и техники АПК*, 12: 14–17.

Chukuridi S.S., Krichevskaya L.S., Sionova N.A. 2012. Lekarstvennyye rasteniya i ikh ispol'zovaniye v fitoterapii [Medicinal plants and their use in herbal medicine]. Krasnodar, Publ. KubGAU, 56 p.

Чукуриди С.С., Кричевская Л.С., Сионова Н.А. Лекарственные растения и их использование в фитотерапии. 2012. Краснодар: КубГАУ, 56 с.

Dumacheva E.V., Chernyavskikh V.I. 2014. The influence of method of hybrid alfalfa (*Medicago varia* Mart.) cultivation on seed productivity of the first generation posterity on calcareous soils of the Central Chernozem region. *Kormoproizvodstvo*, 2: 23–25.

Dumacheva E.V., Titovskiy A.G., Filatov S.V., Chernyavskikh V.I. 2017. Issop Lekarstvennyy (*Hyssopus officinalis* L.) Volokonovskiy. Patent na selektsionnoye dostizheniye [Issop Medicinal (*Hyssopus officinalis* L.) Volokonovsky. Selection achievement patent]. RUS 9104. Zayavka № 8353338 ot 30.05.2017.

Dumacheva E.V., Chernyavskikh V.I. 2019. Issop Lekarstvennyy (*Hyssopus Officinalis* L.) Lazar'. Patent na selektsionnoye dostizheniye [Issop Medicinal (*Hyssopus Officinalis* L.) Lazar'. Selection achievement patent]. RUS 11396. Zayavka № 79351 ot 17.10.2019.

Dumacheva E.V., Cherniavskih V.I., Tokhtar V.K., Tokhtar L.A., Pogrebnyak T.A., Horolskaya E.N., Gorbacheva A.A., Vorobyova O.V., Glubsheva T.N., Markova E.I., Filatov S.V. 2017. Biological resources of the Hyssopus L. on the south of European Russia and prospects of its introduction. *International Journal of Green Pharmacy*, 11(3): 476–480.

Cherniavskih V.I., Dumacheva E.V., Gorbacheva A.A., Vorobyova O.V., Ermakova L.R. 2018. The use of morphobiological characteristics in the selection of *Phacelia tanacetifolia* Benth. *International Journal of Green Pharmacy*, 12(2): 433–436.

Cherniavskih V.I., Sidelnikov N.I., Dumacheva E.V., Borodaeva Z.A., Glubsheva T.N., Gorbacheva A.A., Vorobyova O.V., Korolkova S. 2019 a. Biological resources of natural forage grassland of the cretaceous south of the European Russia. *EurAsian Journal of BioSciences*, 13(2): 845–849.

Cherniavskih V.I., Dumacheva E.V., Borodaeva Z.A., Gorbacheva A.A., Horolskaya E.N., Kotsareva N.V., Korolkova S.V., Gagieva L.C. 2019 b. Features of intra population variability of *Medicago varia* Mart. with the expressed mf-mutation on a complex qualitative characteristics. *EurAsian Journal of BioSciences*, 13(2): 733–737.

Cherniavskih V.I., Dumacheva E.V., Lisetsky F.N., Batlutskaya I.V., Tsugkieva V.B. 2019 c. Impact of endemic calciphilous flora of the Central Russian upland on the nitrogen regime of carbonate soils and sub-soils. *Bioscience Biotechnology Research Communications*, 12 (3): 548–554. DOI: 10.21786/bbrc/12.3/1

Chernyavskikh V.I., Dumacheva E.V., Sidelnikov N.I., Lisetsky F.N., Gagieva L.Ch. 2019 a. Use of *Hissopus officinalis* L. culture for phytoamelioration of carbonate outcrops of anthropogenic origin the south of European Russia. *Indian Journal of Ecology*, 46(2): 221–226.

Chernyavskikh V.I., Dumacheva E.V., Lisetsky F.N., Tsugkiev B.G., Gagieva L.Ch. 2019 b. Floral variety of Fabaceae Lindl. family in gully ecosystems in the south-west of the central Russian upland. *Bioscience Biotechnology Research Communications*, 12(2): 203–210.

Evstatieva L., Hardalova R., Stoyanova K. 2007. Medicinal plants in Bulgaria: diversity, legislation, conservation and trade. *Phytol Balcan*, 13(3): 415–427.

Fathiazad F., Hamedeyazdan S. 2011. A review on *Hyssopus officinalis* L.: Composition and biological activities. *African Journal of Pharmacy and Pharmacology*, 5(17): 1959–1966. DOI: 10.5897/AJPP11.527

Guardo N.I., Sainz P., Gonzalez-Coloma A., Burillo J. 2017. Trypanocidal effects of essential oils from selected medicinal plants. Synergy among the main components. *Nat. Prod. Commun*., 12 (5): 709–712. DOI: 10.1177/1934578X1701200516

Javadi B., Sahebkar A., Emami S.A. 2017. Medicinal plants for the treatment of asthma: A traditional Persian medicine perspective. *Curr. Pharm. Des*., 23(11): 1623–1632. DOI: 10.2174/1381612822666161021143332

Lisetsky F.N., Vladimirov D., Cherniavskih V. 2019. Evaluation of soil biological activity by a vertical profile and erosion catena. *Bioscience Biotechnology Research Communications*, 12(1): 7–16. DOI: 10.21786/bbrc/12.1.2

Popova A., Mihaylova D. 2018. A review of the medicinal plants in Bulgaria – collection, storage, and extraction techniques. *Asian Journal of Pharmaceutical and Clinical Research*, 11(3): 28–35. DOI: 10.22159/ajpcr.2018.v11i3.22994

Semerdjieva I.B., Burducea M., Astatkie T., Zheljazkov V.D., Dincheva I. 2019. Essential oil composition *of Ruta graveolens* L. fruits and *Hyssopus officinalis* subsp. *Aristatus* (Godr.) Nyman biomass as a function of hydrodistillation time. *Molecules*, 24(22): 4047. DOI: 10.3390/molecules24224047

Tahir M., Khushtar M., Fahad M., Rahman M.A. 2018. Phytochemistry and pharmacological profile of traditionally used medicinal plant Hyssop (*Hyssopus officinalis* L.). *Journal of Applied Pharmaceutical Science*, 8(7): 132–140. DOI: 10.7324/JAPS.2018.8721

Zagorcheva Tz., Rusanov Kr., Rusanova M., Aneva I., Stancheva I., Atanassov I. 2020. Genetic and flower volatile diversity in two natural populations of *Hyssopus officinalis* L. in Bulgaria. *Biotechnology & Biotechnological Equipment*, 34(1): 1265–1272. https://doi.org/10.1080/13102818.2020.1835537

Конфликт интересов: о потенциальном конфликте интересов не сообщалось.
Conflict of interest: no potential conflict of interest related to this article was reported.

ИНФОРМАЦИЯ ОБ АВТОРАХ

Филатов Сергей Васильевич, преподаватель, Корочанский сельскохозяйственный техникум, Белгородская область, г. Короча, Россия

Думачев Дмитрий Владимирович, онколог-химиотерапевт, Белгородский онкологический диспансер, г. Белгород, Россия

INFORMATION ABOUT THE AUTHORS

Filatov Sergey V., teacher, Korochansk Agricultural College, Belgorod Region, Korocha, Russia

Dumachev Dmitry V., oncologist-chemotherapist, Belgorod Oncological Dispensary, Belgorod, Russia